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2. Certificate of Service: It is hereby certified that this submission has been served on the applicant in accordance with 37 CFR 1.248 by mailing a copy of this submission along with the two cited publications by first class mail to Applicants attorney of record:

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3. In accordance with the timeliness requirement it is hereby stated that the publications submitted herewith could not have been submitted earlier than the date of publication of the most recent amendments to the claims, namely 18 November 2005. This submission is being made within two months of that date.

Respectfully submitted,

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Technical Specification

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(3G TS 23.122 version 3.1.0 Release 1999)**



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Foreword

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Foreword

This Technical Specification has been produced by the 3GPP.

This TS specifies functions related to Mobile Station (MS) in idle mode and within the 3GPP system.

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of this TS, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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- z the third digit is incremented when editorial only changes have been incorporated in the specification;

1 Scope

Text to be added.

1.1 Normative references

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.
- For this Release 1998 document, references to GSM documents are for Release 1998 versions (version 7.x.y).

- [1] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".
- [2] GSM 02.01: "Digital cellular telecommunications system (Phase 2+); Principles of telecommunications services supported by a GSM Public Land Mobile Network (PLMN)".
- [3] GSM 02.02: "Digital cellular telecommunication system (Phase 2+); Bearer Services (BS) supported by a GSM Public Land Mobile Network (PLMN)".
- [4] GSM 02.03: "Digital cellular telecommunications system (Phase 2+); Teleservices supported by a GSM Public Land Mobile Network (PLMN)".
- [5] GSM 02.04: "Digital cellular telecommunications system (Phase 2+); General on supplementary services".
- [6] GSM 02.06: "Digital cellular telecommunications system (Phase 2+); Types of Mobile Stations (MS)".
- [7] GSM 02.07: "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) features".
- [8] GSM 02.09: "Digital cellular telecommunications system (Phase 2+); Security aspects".
- [9] GSM 02.11: "Digital cellular telecommunications system (Phase 2+); Service accessibility".
- [10] GSM 02.16: "Digital cellular telecommunications system (Phase 2+); International Mobile station Equipment Identities (IMEI)".
- [11] GSM 02.17: "Digital cellular telecommunications system (Phase 2+); Subscriber identity modules Functional characteristics".
- [12] GSM 02.24: "Digital cellular telecommunications system (Phase 2+); Description of Charge Advice Information (CAI)".
- [13] GSM 02.30: "Digital cellular telecommunications system (Phase 2+); Man-Machine Interface (MMI) of the Mobile Station (MS)".
- [14] GSM 02.40: "Digital cellular telecommunications system (Phase 2+); Procedures for call progress indications".
- [15] GSM 02.41: "Digital cellular telecommunications system (Phase 2+); Operator determined barring".

- [16] GSM 02.81: "Digital cellular telecommunications system (Phase 2+); Line identification supplementary services - Stage 1".
- [17] GSM 02.82: "Digital cellular telecommunications system (Phase 2+); Call Forwarding (CF) supplementary services - Stage 1".
- [18] GSM 02.83: "Digital cellular telecommunications system (Phase 2+); Call Waiting (CW) and Call Hold (HOLD) supplementary services - Stage 1".
- [19] GSM 02.84: "Digital cellular telecommunications system (Phase 2+); MultiParty (MPPTY) supplementary services - Stage 1".
- [20] GSM 02.85: "Digital cellular telecommunications system (Phase 2+); Closed User Group (CUG) supplementary services - Stage 1".
- [21] GSM 02.86: "Digital cellular telecommunications system (Phase 2+); Advice of Charge (AoC) supplementary services - Stage 1".
- [22] GSM 02.88: "Digital cellular telecommunications system (Phase 2+); Call Barring (CB) supplementary services - Stage 1".
- [23] GSM 04.08: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".
- [24] GSM 05.02: "Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path".
- [25] GSM 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".
- [26] GSM 02.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service description Stage 1".
- [27] GSM 03.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service description Stage 2".
- [28] GSM 03.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the GPRS Radio Interface; Stage 2".
- [29] GSM 02.56: "Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS); Service Description; Stage 1
- [30] GSM 03.56: "Digital cellular telecommunications system (Phase 2+); GSM Cordless Telephony System (CTS); CTS Architecture Description; Stage 2

1.2 Definitions and abbreviations

Abbreviations used in this TS are listed in GSM 01.04.

Home PLMN

This is a PLMN where the MCC and MNC of the PLMN identity match the MCC and MNC IMSI. Matching criteria are defined in Annex A.

Selected PLMN

This is the PLMN that has been selected according to subclause 3.1, either manually or automatically.

This is a PLMN where the MS has found a cell that satisfies conditions (ii) and (iv) of 3.2.2. Outcomes have occurred (see table

- Registration** This is the process of camping on a cell of the PLMN and doing any necessary LRs.
- Camped on a cell** The MS (ME if there is no SIM) has completed the cell selection/reselection process and has chosen a cell from which it plans to receive all available services. Note that the services may be limited, and that the PLMN may not be aware of the existence of the MS (ME) within the chosen cell.
- Current serving cell** This is the cell on which the MS is camped.
- Suitable Cell** This is a cell on which an MS may camp. It must satisfy criteria defined in TS 03.22 subclause 3.2.1.
- Acceptable Cell** This is a cell that the MS may camp on to make emergency calls. It must satisfy criteria defined in TS 03.22 sub clause 3.2.2.
- GPRS MS** An MS capable of GPRS services is a GPRS MS.
- CTS MS** An MS capable of CTS services is a CTS MS.
- Location Registration (LR)** An MS which is IMSI attached to non-GPRS services only performs location registration by the Location Updating procedure. A GPRS MS which is IMSI attached to GPRS services or to GPRS and non-GPRS services performs location registration by the Routing Area Update procedure only when in a network of network operation mode I. Both procedures are performed independently by the GPRS MS when it is IMSI attached to GPRS and non-GPRS services in a network of network operation mode II or III (see GSM 03.60).
- Localised Service Area (LSA)** A localised service area consists of a cell or a number of cells. The cells constituting a LSA may not necessarily provide contiguous coverage.
- Network Type** The network type associated with HPLMN or a PLMN on the PLMN selector (see GSM 11.11). The MS uses this information to determine what type of radio carrier to search for when attempting to select a specific PLMN. A PLMN may support more than one network type.
- SoLSA exclusive access** Cells on which normal camping is allowed only for MS with Localised Service Area (LSA) subscription.
- Registration Area** A registration area is an area in which mobile stations may roam without a need to perform location registration. The registration area corresponds to location area (LA) for performing location updating procedure and it corresponds to routing area for performing the routing area update procedure.
- The PLMN to which a cell belongs (PLMN identity) is given in the system information transmitted on the BCCH (MCC + MNC part of LAI).
- In GSM,...** Indicates this paragraph applies only to GSM System. For multi system case this is determined by the current serving radio access network.
- In UMTS,...** Indicates this paragraph applies only to UMTS System. For multi system case this is determined by the current serving radio access network.
- (GSM only)** Indicates this section or paragraph applies only to GSM system. For multi system case this is determined by the current serving radio access network.
- (UMTS only)** Indicates this section or paragraph applies only to UMTS system. For multi system case this is determined by the current serving radio access network.
- SIM** Subscriber Identity Module (see TS GSM 02.17). This specification makes no distinction between SIM and USIM.
- MS** Mobile Station. This specification makes no distinction between MS and UE.

2 General description of idle mode

When an MS is switched on, it attempts to make contact with a GSM public land mobile network (PLMN). The particular PLMN to be contacted may be selected either automatically or manually. The MS looks for a suitable cell of the chosen PLMN and chooses that cell to provide available services, and tunes to its control channel. This choosing is known as "camping on the cell". The MS will then register its presence in the registration area of the chosen cell if necessary, by means of a location registration (LR), GPRS attach or IMSI attach procedure. If the MS loses coverage of a cell, it reselects onto the most suitable alternative cell of the selected PLMN and camps on that cell. If the new cell is in a different registration area, an LR request is performed. If the MS loses coverage of a PLMN, either a new PLMN is selected automatically, or an indication of which PLMNs are available is given to the user, so that a manual selection can be made.

Registration is not performed by MSs only capable of services which need no registration for example GPRS services PTM-M or PTP anonymous access.

The purpose of camping on a cell in idle mode is threefold:

- a) It enables the MS to receive system information from the PLMN.
- b) If the MS wishes to initiate a call, it can do this by initially accessing the network on the control channel of the cell on which it is camped (with the exceptions defined in TS 03.22 subclauses 3.5.3 and 3.5.4).
- c) If the PLMN receives a call for the MS, it knows (in most cases) the registration area of the cell in which the MS is camped. It can then send a "paging" message for the MS on control channels of all the cells in the registration area. The MS will then receive the paging message because it is tuned to the control channel of a cell in that registration area, and the MS can respond on that control channel.

If the MS is unable to find a suitable cell to camp on, or the SIM is not inserted, or if it receives certain responses to an LR request (e.g., "illegal MS"), it attempts to camp on a cell irrespective of the PLMN identity, and enters a "limited service" state in which it can only attempt to make emergency calls.

If the CTS MS is in CTS mode only or in automatic mode with CTS preferred, it will start by attempting to find a CTS fixed part on which it is enrolled

The idle mode tasks can be subdivided into 4 processes:

- PLMN selection;
- Cell selection and reselection;
- Location registration;
- CTS fixed part selection.

To make this initial CTS fixed part selection, the MS shall be enrolled on at least one fixed part.

The relationship between these processes is illustrated in figure 1. The states and state transitions within each process are shown in figures 2 to 4.

3 Requirements and technical solutions

The following subclauses list the main requirements of idle mode operation and give an outline of the technical solution.

3.1 PLMN selection and roaming

The MS normally operates on its home PLMN (HPLMN). However a visited PLMN (VPLMN) may be selected, e.g., if the MS loses coverage. There are two mandatory modes for PLMN selection:

- i) Automatic mode - This mode utilizes a list of PLMNs in priority order. The highest priority PLMN which is available and allowable is selected.
- ii) Manual mode - Here the MS indicates to the user which PLMNs are available. Only when the user makes a manual selection does the MS try to obtain normal service on the VPLMN.

Optionally, an MS may support additional modes for PLMN selection:

Mobiles supporting GPRS:

- iii) GPRS mode - This mode prioritises PLMNs which support GPRS services, but is otherwise similar to the Automatic mode (above).

There are two cases:

- International Roaming - This is where the MS receives service on a PLMN of a different country than that of the HPLMN.
- National Roaming - This is where the MS receives service from a PLMN of the same country as that of the HPLMN, either anywhere or on a regional basis. The MS makes a periodic search for the HPLMN while national roaming.

To prevent repeated attempts to have roaming service on a not allowed LA, when the MS is informed that an LA is forbidden, the LA is added to a list of "forbidden LAs for roaming" which is stored in the MS. This list is deleted when the MS is switched off or when the SIM is removed. Such area restrictions are always valid for complete location areas independent of possible subdivision into GPRS routing areas. The structure of the routing area identifier (GSM 03.03) supports area restriction on LA basis.

If a "PLMN not allowed" message is received by an MS in response to an LR request from a VPLMN, that VPLMN is added to a list of "forbidden PLMNs" in the SIM and thereafter that VPLMN will not be accessed by the MS when in automatic mode. A PLMN is removed from the "forbidden" list if, after a subsequent manual selection of that PLMN, there is a successful LR. This list is retained when the MS is switched off or the SIM is removed. The HPLMN shall not be stored on the list of "forbidden PLMNs".

A ME not supporting SoLSA may consider a cell with the escape PLMN code (see GSM 03.73) to be a part of a PLMN belonging to the list of "forbidden PLMNs".

Optionally the ME may store in its memory an extension of the forbidden PLMN list. The contents of the extension of the list shall be deleted when the MS is switched off or the SIM is removed.

3.2 Regional provision of service

An MS may have a "regionally restricted service" where it can only obtain service on certain LAs. If such an MS attempts to camp on a cell of an LA for which it does not have service entitlement, when it does an LR request, it will receive an "LA not allowed" message. In this case:

- The MS stores the forbidden LA identity (LAI) in a list of "forbidden LAIs for regional provision of service", to prevent repeated access attempts on a cell of the forbidden LA. This list is deleted when the MS is switched off or the SIM is removed. If the MS cannot find a suitable cell, the MS performs the PLMN selection procedure starting at subclause 4.4.3.1 A or B

In GSM, a cell may be reserved for SoLSA exclusive access (see GSM 04.08 and 04.60). An MS is only allowed to camp normally on such a cell if it has a Localised Service Area subscription to the cell. Other MS may camp for limited service.

NOTE: In GSM, in a SoLSA exclusive cell the MCC+MNC code is replaced by an unique escape PLMN code (see GSM 03.73), not assigned to any PLMN, in SI3 and SI4. An MS not supporting SoLSA may request for location update to an exclusive access cell. In this case the location attempt is rejected with the cause "PLMN not allowed" and the escape PLMN code is added to the list of the "forbidden PLMNs".

3.3 Borders between registration areas

If the MS is moving in a border area between registration areas, it might repeatedly change between cells of different registration areas. Each change of registration area would require an LR, which would cause a heavy signalling load and increase the risk of a paging message being lost. The access stratum shall provide a mechanism to limit this effect.

3.4 Access control

3.4.1 Access control

Due to problems in certain areas, Network Operators may decide to restrict access from some MSs (e.g., in case of congestion), and for this reason an access control mechanism shall be provided.

3.4.2 Forbidden LA for regional provision of service

When the MS is camped on a cell, the LA of which belongs to the list of forbidden LA for regional provision of service, the MS is not allowed to initiate establishment of a CM connection except for an emergency call; it may respond to paging. Also, the MS is not allowed to request GPRS services when camped on a cell of a LA of which belongs to the list of forbidden LA.

3.5 No suitable cell (limited service state)

There are a number of situations in which the MS is unable to obtain normal service from a PLMN. These include:

- a) Failure to find a suitable cell of the selected PLMN;
- b) No SIM in the MS;
- c) A "PLMN not allowed" response to an LR;
- d) An "illegal MS", "illegal ME" or "IMSI unknown in HLR" response to an LR; (Any SIM in the ME is then considered "invalid".)
- e) A "GPRS not allowed" response to an LR of a GPRS MS attached to GPRS services only. (The cell selection state of GPRS MSs attached to GPRS and non-GPRS depends on the outcome of the location updating.)

(In automatic PLMN selection mode, events (a), (c) and (e) would normally cause a new PLMN selection, but even here, the situation may arise when no PLMNs are available and allowable for use).

Under any of these conditions, the MS attempts to camp on an acceptable cell, irrespective of its PLMN identity, so that emergency calls can be made if necessary. When in the limited service state with a valid SIM, the MS shall search for available and allowable PLMNs in the manner described in subclause 4.4.3.1 and when indicated in the SIM also as described in subclause 4.4.3.4. No LR requests are made until a valid SIM is present and either a suitable cell is found or a manual network reselection is performed. In the limited service state the presence of the MS need not be known to the PLMN on whose cell it has camped.

There are also other conditions under which only emergency calls may be made. These are shown in table 2.

3.6 CTS fixed part selection (GSM only)

In CTS mode only or in automatic mode with CTS preferred, the CTS MS normally operates on a CTS fixed part on which the mobile station is already enrolled. If the CTS MS loses CTS coverage in these modes, it shall attempt periodically to select again a CTS fixed part.

To select a CTS fixed part, the CTS MS shall listen to the CTSBCH frequencies of all the fixed parts on which the MS is currently enrolled.

If the CTS MS is moving in a border area between one area with CTS coverage and one without it, it might repeatedly require CTS attachments and LU on the PLMN. To prevent this, the criteria C1_CTS and C2_CTS (defined in GSM 05.08 subclause 11.1) are used. To attach to a CTS FP, the C1_CTS criterion shall be greater than zero. When the C2_CTS criterion falls below zero, the CTS MS shall consider itself to be no more under CTS coverage.

4 Overall process structure

4.1 Process goal

The aim of the idle mode processes is to ensure that the registered PLMN is the selected PLMN.

4.2 States description

Each of the processes of PLMN selection, cell selection and location registration can be described by a set of states. The overall state of the mobile is thus a composite of the states of the three processes. In some cases, an event which causes a change of state in one process may trigger a change of state in another process, e.g., camping on a cell in a new registration area triggers an LR request. The relationship between the processes is illustrated in figure 1.

The states in which the MS may be, for each of the processes, are described below and illustrated in figures 2 to 4. For many of the states, a fuller description can be found in other GSM Technical Specifications, and a reference to the GSM Technical Specification and the relevant section within it, are given after the state description.

In the event of any conflict between the diagrams and the text in this ETS, the text takes precedence.

4.3 List of states

4.3.1 List of states for the PLMN selection

- M2 On PLMN - The MS has successfully registered on a PLMN.
- M3 Not on PLMN - The MS has failed to register on the selected PLMN.
- M4 Trying PLMN - The MS is trying to register on a user selected PLMN.
- M5 No SIM - There is no SIM in the MS, or certain LR responses have been received.

4.3.2 List of states for location updating (figure 3)

The states are entered depending on responses to location update (LU) requests.

4.3.3 List of states for location registration (figure 3)

The states are entered depending on responses to location registration (LR) requests. Independent update states exist for GPRS and for non-GPRS operation in MSs capable of GPRS and non-GPRS services.

- L1 Updated - The MS enters this state if an LR request is accepted. The update status is set to "updated". The GPRS and the non-GPRS update state of a MS may enter "updated" as a result of combined signalling or as a result of individual signalling depending on the capabilities of the network.
- L2 Idle, No IMSI - The MS enters this state if an LR request is rejected with cause:
 - a) IMSI unknown in HLR;
 - b) illegal ME;
 - c) illegal MS;
 - d) GPRS not allowed;

or if there is no SIM. All update states of a MS enter this state regardless whether received by individual or combined signalling for events b) and c). Event a) results in "Roaming not allowed" for the non-GPRS update state only. Event a) has no influence on the GPRS update state. Event d) results in "Roaming not allowed" for the GPRS update state only. Event d) has no influence on the non-GPRS update state.

If a SIM is present, the non-GPRS update status of the SIM is set to "Roaming not allowed" for events a), b) and c).
- L3 Roaming not allowed - The MS enters this state if it receives an LU reject message with the cause:
 - a) PLMN not allowed;
 - b) Location area not allowed;
 - c) Roaming not allowed in this location area.

All update states of the MS are set to "Roaming not allowed" regardless whether received by individual or combined signalling. The behaviour of the MS in the roaming not allowed state is dependent on the LR reject cause as shown in table 2. Additionally:

 - in automatic mode, "PLMN not allowed" and "roaming not allowed in this location area" cause the Automatic Network Selection procedure of subclause 4.4.3.1A to be started; it is also caused by "GPRS not allowed" when received by a MS capable of GPRS only;
 - in manual mode, "PLMN not allowed" and "roaming not allowed" cause the Manual Network Selection procedure of subclause 4.4.3.1B to be started; it is also caused by "GPRS not allowed" when received by MS capable of GPRS only.
- L4 Not updated - The MS enters this state if any LR failure not specified for states L2 or L3 occurs, in which cases the MS is not certain whether or not the network has received and accepted the LR attempt. The non-GPRS update status on the SIM and/or the GPRS update status are set to "not updated" depending on the specific location registration procedure and their outcome.

4.4 PLMN selection process

4.4.1 Introduction

There are two mandatory modes for PLMN selection, automatic and manual. Optionally other modes may be supported. The mandatory modes and one optional mode are described in subclauses 4.4.3 below, Manual and Automatic mode are illustrated in figures 2a to 2b.

4.4.2 Registration on a PLMN

The MS shall perform registration on the PLMN if the MS is capable of services which require registration. In all PLMN selection modes, the concept of registration on a PLMN is used. An MS successfully registers on a PLMN if:

- a) The MS has found a suitable cell of the PLMN to camp on; and
- b) An LR request from the MS has been accepted in the registration area of the cell on which the MS is camped (see table 1).

4.4.3 PLMN selection

The registration on the selected PLMN and the location registration are only necessary if the MS is capable of services which require registration. Otherwise, the PLMN selection procedures are performed without registration.

4.4.3.1 At switch-on or recovery from lack of coverage

At switch on, the MS selects and attempts to perform a Location Registration on the registered PLMN, if it exists. On recovery from lack of coverage, the MS selects the registered PLMN (if it exists) and, if necessary (see subclause 4.5.2) attempts to perform a Location Registration.

If successful registration is achieved, the MS indicates the selected PLMN.

If there is no registered PLMN, or if registration is not possible due to the PLMN being unavailable or registration failure, the MS follows one of the following procedures depending on its operating mode.

EXCEPTION: If registration is not possible on recovery from lack of coverage due to the registered PLMN being

PLMN selector specifies more than one network type, the MS may scan for network types in the order of the time it takes to identify them (with the exception of requirement b), starting with the network type that takes the shortest time to identify.

- d) In step iii and iv, the MS shall search for all network types it is capable of, with the exception of requirement b), before deciding which PLMN to select.
- e) A MS that does not have any stored network type information on the SIM shall first go through the steps by only searching for the BCCH network type. If no successful registration is achieved, then the COMPACT capable MS without GSM voice shall redo the procedure assuming that all PLMNs may be supporting all network types.

NOTE: Requirements a) and b) do not apply to MSs supporting GSM circuit-switched data without supporting GSM voice.

NOTE: High quality signal is defined in the appropriate AS specification.

If successful registration is achieved, the MS indicates the selected PLMN.

If registration cannot be achieved because no PLMNs are available and allowable, the MS indicates "no service" to the user, waits until a new PLMN is available and allowable and then repeats the procedure.

If there were one or more PLMNs which were available and allowable, but an LR failure made registration on those PLMNs unsuccessful or an entry in a forbidden LAI list prevented a registration attempt, the MS selects the first such PLMN again and enters a limited service state.

4.4.3.1.2 Manual Network Selection Mode Procedure

The MS indicates whether there are any PLMNs, in all of its bands of operation, which are available. This includes "Forbidden PLMNs". Any PLMN shall only be presented once.

If displayed, PLMNs meeting the criteria above are presented in the following order:

- i) HPLMN;
- ii) PLMNs contained in the "PLMN Selector" data field in the SIM (in priority order);
- iii) other PLMNs with received high quality signal in random order;
- iv) all other PLMNs in order of decreasing signal quality.

The user may select his desired PLMN and the MS then initiates registration on this PLMN. (This may take place at any time during the presentation of PLMNs). For such a registration, the MS shall ignore the contents of the forbidden LAI and PLMN lists.

The MS may optionally indicate which services (e.g. GPRS) are supported by the PLMNs shown in the list.

If the user does not select a PLMN, the selected PLMN shall be the one that was selected before the PLMN selection procedure started. If no such PLMN was selected or that PLMN is no longer available, then the MS shall attempt to camp on any acceptable cell and enter the limited service state.

NOTE: The scan in manual network selection mode includes PLMNs having cells with CELL_BAR_QUALIFY_2 transmitted and cells with CPBCHs.

NOTE: High quality signal is defined in the appropriate AS specification.

4.4.3.1.3. GPRS Network Selection Mode Procedure

The MS selects and attempts registration on other PLMNs, if available and allowable, in all of its bands of operation in the following order:

- i) HPLMN
- ii) each PLMN in the "PLMN Selector" data field in the SIM which supports GPRS services (in priority order);
- iii) other PLMNs with received signal level above -85 dBm which support GPRS services in random order;

- iv) all other PLMNs which support GPRS services in order of decreasing signal strength.
- v) each PLMN in the "PLMN Selector" data field in the SIM (in priority order);
- vi) other PLMNs with received signal level above -85 dBm in random order;
- vii) all other PLMNs in order of decreasing signal strength.

NOTE: This is basically the same order as for Automatic Network Selection, except that PLMNs which support GPRS services take priority over those which do not.

The MS can determine if a PLMN supports GPRS according to the rules defined in section 4.4.3.4

If successful registration is achieved, the MS indicates the selected PLMN.

If registration cannot be achieved because no PLMNs are available and allowable, the MS indicates "no service" to the user, waits until a new PLMN is available and allowable and then repeats the procedure.

If there were one or more PLMNs which were available and allowable, but an LR failure made registration on those PLMNs unsuccessful or an entry in a forbidden LAI list prevented a registration attempt, the MS selects the first such PLMN again and enters a limited service state.

If the PLMN selected does not support GPRS services then optionally the MS may start a timer. The timer value is implementation dependent but shall not be shorter than 30 minutes. On expiry of the timer the MS scans for GPRS PLMNs. If (and only if) a PLMN which supports GPRS is available and allowable then the MS may register on this PLMN. The priority order listed above still applies.

4.4.3.2 User reselection

At any time the user may request the MS to initiate reselection and registration onto an available PLMN, according to the following procedures, dependent upon the operating mode.

4.4.3.2.1 Automatic Network Reselection Mode

This user reselection procedure can be used when the MS is in Automatic Network Selection mode.

The MS selects and attempts registration on PLMNs, if available and allowable, in all of its bands of operation in accordance with the following order:

- i) HPLMN;
- ii) PLMNs contained in the "PLMN Selector" data field in the SIM (in priority order) excluding the previously selected PLMN;
- iii) Other PLMNs with the received high quality signal in random order excluding the previously selected PLMN;
- iv) Any other PLMNs, excluding the previously selected PLMN in order of decreasing signal quality or, alternatively, the previously selected PLMN may be chosen ignoring its signal quality;
- v) The previously selected PLMN.

When following the above procedure the following requirements apply:

- a) An MS with GSM voice capability shall ignore PLMNs for which the MS has identified at least one cell that transmits CELL_BAR_QUALIFY_2.
- b) An MS with GSM voice capability shall not search for CPBCCCH carriers.
- c) In step i and ii, the MS should limit its search of network types to the one associated with the PLMN which it is attempting to select and register to (HPLMN or any PLMN on the PLMN selector). If a PLMN entry on the PLMN selector specifies more than one network type, the MS may scan for network types in the order of the time it takes to identify them (with the exception of requirement b), starting with the network type that takes the shortest time to identify.

- d) In step iii, iv, and v, the MS shall search for all network types it is capable of, with the exception of requirement b), before deciding which PLMN to select.
- e) A MS that does not have any stored network type information on the SIM shall first go through the steps by only searching for the BCCH network type. If no successful registration is achieved, then the COMPACT capable MS without GSM voice shall redo the procedure assuming that all PLMNs may be supporting all network types.

NOTE: Requirements a) and b) do not apply to MSs supporting GSM circuit-switched data without supporting GSM voice. The previously selected PLMN is the PLMN which the MS has selected prior to the start of the user reselection procedure

NOTE: High quality signal is defined in the appropriate AS specification.

4.4.3.2.2 Manual Network ReSelection

This user reselection procedure is used when the MS is in Manual Network Selection mode.

The Manual Network Selection Mode Procedure of subclause 4.4.3.2 is followed.

4.4.3.2.3 Semi Automatic Network ReSelection

This user reselection procedure is an MS option. Where implemented, it can be performed by the user in any network selection mode except for Manual Network Selection mode.

The MS indicates whether there are any PLMNs, in all of its bands of operation, which are available. This shall include any "Forbidden PLMNs". The current registered PLMN is included in the list. Any PLMN shall only be presented once.

If displayed, PLMNs meeting the criteria above are presented in the following order:

- i) HPLMN;
- ii) PLMNs contained in the "PLMN Selector" data field in the SIM (in priority order);
- iii) other PLMNs with received signal level above -85 dBm in random order;
- iv) all other PLMNs in order of decreasing signal strength.

The MS should indicate which optional services (e.g. GPRS) the displayed PLMNs support. The MS can determine if a PLMN supports GPRS according to the rules defined in section 4.4.3.4

The MS may also indicate which PLMN is the current registered PLMN, and which PLMNs are "Forbidden PLMNs".

The user may select his desired PLMN and the MS then initiates registration on this PLMN. (This may take place at any time during the presentation of PLMNs). For such a registration, the MS shall ignore the contents of the forbidden LAI and PLMN lists. If this registration fails the available PLMNs are displayed again.

If the user does not select a PLMN, or if a registration fails, the MS shall select a network according to rules defined for the currently selected Network Selection Mode (see section 4.4.3.2). However as soon as the user chooses a PLMN any existing search procedures are aborted in favour of the user's preferred choice.

4.4.3.3 In VPLMN of home country

The MS shall periodically attempt to obtain service on its HPLMN by scanning in accordance with the requirements that are applicable to step i) as defined in the Automatic Network Selection Mode. For this purpose, a value T minutes may be stored in the SIM, T is either in the range 6 minutes to 8 hours in 6 minute steps or it indicates that no periodic attempts shall be made. If no value is stored in the SIM, a default value of 30 minutes is used.

The attempts to access the HPLMN shall be as specified below:

- a) The periodic attempts shall only be performed in automatic mode when the MS is roaming in its home country;

- b) After switch on, a period of at least 2 minutes and at most T minutes shall elapse before the first attempt is made;
- c) The MS shall make an attempt if the MS is on the VPLMN at time T after the last attempt;
- d) Periodic attempts shall only be performed by the MS while in idle mode;
- e) If the HPLMN is not found, the MS shall remain on the VPLMN.

4.4.3.4. Determination of Support of GPRS Services

An MS can determine if the PLMN supports GPRS services by analysis of the broadcast system information. If the mobile can see several cells of the same PLMN but only some of them support GPRS, it is an implementation option whether the mobile considers the PLMN to support GPRS.

4.4.3.5 Investigation Scan for higher prioritized PLMN

A MS capable of both voice and packet service shall, when indicated in the SIM, investigate if there is service from a higher prioritized PLMN not offering voice service, either HPLMN or a PLMN in the "PLMN Selector" data field in the SIM. The scan shall be performed in accordance with the requirements described for automatic network selection mode in subclause 4.4.3.1 that are applicable to step i) and step ii) with the exception of requirement a) and b) in subclause 4.4.3.1. Requirement a) and b) that are specified for automatic network selection mode in subclause 4.4.3.1 shall be ignored during the investigation scan.

The investigation scan for higher prioritized PLMN shall be as specified below:

- a) The scan shall only be performed in automatic network selection mode;
- b) The scan shall only be performed by an MS that is capable of both voice and packet;
- c) The scan shall only be performed if the serving PLMN is not the highest prioritized PLMN in the current country (HPLMN in home country, otherwise according to the PLMN selector list);
- d) The scan shall be performed at least once after a successful PLMN selection is completed;
- e) The investigation scan should be performed when the MS enters idle mode;

The MS shall return to RPLMN after the investigation scan is performed.

Note: The MS remains on the RPLMN independent of the outcome of the investigation scan. The purpose of the investigation scan is to check if there is a higher prioritized PLMN, not to select it.

4.4.4 Abnormal cases

If there is no SIM in the MS, if there is an authentication failure, or if the MS receives an "IMSI unknown in HLR", "illegal ME" or "illegal MS" response to an LR request, then effectively there is no selected PLMN ("No SIM" state). In these cases, the states of the cell selection process are such that no PLMN selection information is used. No further attempts at registration on any PLMN are made until the MS is switched off and on again, or a SIM is inserted.

When in Automatic Network Selection mode (or in GPRS Network Selection Mode) the MS is in the "not updated" state with one or more suitable cells to camp on; then after the maximum allowed unsuccessful LR requests (controlled by the specific attempt counters) the MS may continue (or start if it is not running) the user reselection procedure of 4.4.3.2 1.

4.4.5 Roaming not allowed in this LA

If in either PLMN selection mode the LR response "Roaming not allowed in this LA" is received:

The PLMN Selection Procedure of subclause 4.4.3.1 are followed, depending on the PLMN selection mode.
(This requirement applies to all MSs.)

4.5 Location registration process

4.5.1 General

When the MS is switched on and capable of services requiring registration, the action taken by the location registration process is as follows:

- a) SIM present and no LR needed (because of the status of the stored registration area identity and "attach" flag):
The MS is in the update state UPDATED;
- b) SIM present and LR needed: A LR request is made;
- c) No SIM present: The MS enters the update state Idle, NO IMSI.

In case b) above, and subsequently whenever a LR request is made, the MS enters a state depending on the outcome of the LR request, as listed in subclause 4.3.2 above. In case c) the GPRS and the non-GPRS update state enters "IDLE, NO IMSI".

Whenever the MS goes to connected mode and then returns to idle mode again, the MS selects the appropriate state.

4.5.2 Initiation of Location Registration

An LR request indicating Normal Updating is made when, in idle mode,

- the MS changes cell while being in the update state NOT UPDATED; (for MS capable of GPRS and non-GPRS services when at least one of both update states is NOT UPDATED)
- the MS detects that it has entered a new registration area, i.e., when the received registration area identity differs from the one stored in the MS, and the LAI or the PLMN identity is not contained in a list of forbidden LAIs or PLMN identities respectively, while being in one of the following update states:
 - UPDATED;
 - NOT UPDATED;
 - ROAMING NOT ALLOWED.
- the Periodic Location Updating Timer expires while being in the non-GPRS update state NOT UPDATED (triggers Location Updating);
- the Periodic Routing Area Update timer expires while being in the GPRS update state NOT UPDATED (triggers Routing Area Update);
- a manual network reselection has been performed, an acceptable cell of the selected PLMN is present, and the MS is not in the UPDATED state on the selected PLMN.
- a user PLMN reselection has been performed when the PLMN selection mode is GPRS network selection mode, an acceptable cell of the selected PLMN is present, and the MS is not in the UPDATED state on the selected PLMN.

An LR request indicating Periodic Location Updating is made when, in idle mode, the Periodic Location Updating timer expires while being in the non-GPRS update state UPDATED.

An LR request indicating Periodic Routing Area Update is made when the Periodic Routing Area Update timer expires while being in the GPRS update state UPDATED.

An LR request indicating IMSI attach is made when the MS is activated in the same location area in which it was deactivated while being in the non-GPRS update state UPDATED, and the system information indicates that IMSI attach/detach shall be used.

A GPRS attach is made by a GPRS MS when activated and capable of services which require registration. Depending on system information about GPRS network operation mode MSs capable of GPRS and non-GPRS services perform combined or non-combined location registration procedures. When the combined routing area update or GPRS attach is accepted with indication "MSC not reachable" or is not answered the MS performs also the corresponding location

updating procedure or falls back to a GPRS only MS. When the combined routing area update or GPRS attach is rejected with cause "GPRS not allowed" the GPRS update state is "IDLE, NO IMSI" and the MS performs the corresponding location updating procedure or falls back to a GPRS only MS.

Furthermore, an LR request indicating Normal Location Updating is also made when the response to an outgoing request shows that the MS is unknown in the VLR or SGSN, respectively.

Table 2 summarizes the events in each state that trigger a new LR request. The actions that may be taken while being in the various states are also outlined in table 2.

A GPRS MS which is both IMSI attached for GPRS and non-GPRS services and which is capable of simultaneous operation of GPRS and non-GPRS services shall perform Routing Area Update in connected mode when it has entered a new routing area which is not part of a LA contained in the list of forbidden LAIs.

4.5.3 Periodic Location Registration

A Periodic Location Updating timer (for non-GPRS operation) and a Periodic Routing Area Update timer (for GPRS operation) with the following characteristics shall be implemented in the MS (MS capable of GPRS and non-GPRS operation shall implement both timers):

- i) Upon switch on of the MS or when the system information indicates that periodic location registration shall be applied, and the timer is not running, the timer shall be loaded with a random value between 0 and the broadcast or signalled time-out value and started.
- ii) The time-out value for the Periodic Location Updating timer shall be within the range of 1 deci-hour to 255 deci-hours with a granularity of 1 deci-hour.
- iii) When the timer reaches its expiry value, it shall be initiated with respect to the relevant time-out value, and the MS shall initiate the Periodic Location Registration corresponding to the expired timer.
- iv) The Periodic Location Updating timer shall be prevented from triggering Periodic Location Updating during connected mode. When the MS returns to idle mode, the Periodic Location Updating timer shall be initiated with respect to the broadcast time-out value, then started. Thereafter, the procedure in iii) shall be followed.
- v) The Periodic Routing Area Update timer shall be prevented from triggering the Periodic Routing Area Update during Ready state. At transition from Ready to Standby state the Periodic Routing Area Update timer shall be initiated with respect to its time-out value, then started. Thereafter, the procedure in iii) shall be followed.
- vi) If the MS performs a successful combined Routing Area Update the Periodic Location Updating timer shall be prevented from triggering the Periodic Location Updating until the MS starts using Location Updating procedure, for example because of a changed network operation mode or the MS uses non-GPRS services only.
- vii) When a change in the time-out value occurs (at a change of serving cell or a change in the broadcast time-out value or a change in the signalled time-out value), the related timer shall be reloaded so that the new time to expiry will be: "old time to expiry" modulo "new time-out value".

4.5.4 IMSI attach/detach operation

The system information will contain an indicator indicating whether or not IMSI attach/detach operation is mandatory to use in the cell. The MS shall operate in accordance with the received value of the indicator.

A GPRS MS shall perform GPRS attach/detach procedures independent of the value of the IMSI attach/detach indicator. When a GPRS MS has to perform IMSI attach/detach independent of GPRS procedures (for example GPRS network operation mode 2) the handling described in the paragraph above applies.

When IMSI attach/detach operation applies, a MS shall send the IMSI detach message to the network when the MS is powered down or the SIM is removed while being in the update state UPDATED. The IMSI detach message will not be acknowledged by the network.

When the MS returns to the active state, the MS shall perform an LR request indicating IMSI attach, provided that the MS still is in the same registration area. If the registration area has changed, an LR request indicating Normal Location Updating according to subclause 4.5.2 shall be performed.

4.6 Service indication

This is an indication to the user that service or CTS service is available.

The service indication should be set if the following conditions are all satisfied:

- a) Cell Selection: Camped on a suitable cell and in updated state, or in connected mode having been camped on a suitable cell.
- b) Location registration: In updated state, for MSs capable of services requiring registration.

A specific CTS service indication should be set when the CTS MS is attached to a CTS FP.

However due to the fact that there may be some transitory changes of state, the service indication is permitted to continue to be set for up to 10 seconds after the above conditions cease to be met. Also the service indication is permitted to take up to 1 second to be set after the above conditions are met.

4.7 Pageability of the mobile subscriber

An MS is required to listen to all paging messages that could address it (see GSM 05.02), when the following conditions are all satisfied:

- A SIM is inserted.
- The MS is camped on a cell.
- The MS is not in state "Idle, No IMSI".
- The MS is not performing the task to search for available PLMNs. (Whenever possible during this task, the MS should listen for paging.). However, when the MS is camped on a cell, is registered in a PLMN and is performing its regular search for the HPLMN, as specified in GSM 02.11, then it shall listen to all paging messages that could address it.

NOTE 1: In GSM, during cell reselection there is a certain period when the MS is no longer camped on the old cell but must decode the full BCCH or CPBCH before camping on the new cell. This leads to a period of slightly more than 8 51 frame multiframe when the MS will not necessarily be pageable.

4.8 MM Restart Procedure

In some cases, e.g. on change of SIM data, there is a need for the MM to be restarted without the need for user intervention.

To perform the procedure the MS shall behave as if the SIM is removed and afterwards a new SIM is inserted.

5 Tables and Figures

Table 1: Effect of LR Outcomes on PLMN Registration

Location Registration Task State	Registration Status	Registered PLMN is
Updated	Successful	Indicated in the stored registration area identity
Idle, No IMSI	Unsuccessful	No registered PLMN (3)
Roaming not allowed:		
a) PLMN not allowed	Unsuccessful	No registered PLMN
b) LA not allowed	Indeterminate(1)	No registered PLMN
c) Roaming not allowed in this LA	Indeterminate (2)	No registered PLMN
Not updated	Unsuccessful	No registered PLMN

1) The MS will eventually either enter a different state when the registration status will be determined, or fail to be able to camp on a cell, when registration will be unsuccessful.

2) The MS will select the HPLMN if in automatic mode and will enter Automatic Network Selection Mode Procedure of subclause 4.4.3.1.1. If in manual mode, the MS will display the list of available PLMNs and follow the Manual Network Selection Mode Procedure of subclause 4.4.3.1.2. Other PLMN selection modes will behave in a similar manner. If the appropriate process does not result in registration, the MS will eventually enter the limited service state.

3) A MS may have different update states for GPRS and non-GPRS. A PLMN is registered when at least one of both update states is updated.

NOTE 1: MSs capable of GPRS and non-GPRS services may have different registration status for GPRS and for non-GPRS.

NOTE 2: The registered PLMN is determined by looking at the stored registration area identity and stored location registration status.

Table 2: LR Process States and Allowed Actions

Location registration task state	New LR request when				Normal Calls Supported (1)	Paging responded to
	Changing Cell	Changing registration area	Changing PLMN	Other		
Null (4)	No	Yes	Yes	No	No	No
Updated, (5)	No	Yes	Yes	(2)	Yes	Yes
Idle, No IMSI (7)	No	No	No	No	No	No
Roaming not allowed:						
a) Idle, PLMN not allowed	No	No	Yes	No	No	Optional if with IMSI
b) Idle, LA not allowed	No	Yes(6)	Yes	No	No	Optional if with IMSI
c) Idle, Roaming not allowed in this LA	No	Yes(6)	Yes	No	No	Optional if with IMSI
Not updated	Yes	Yes	Yes	(2)&(3)	(3)	Yes if with IMSI

- 1): Emergency calls may always be made, subject to access control permitting it.
- 2): A new LR is made when the periodic registration timer expires.
- 3): If a normal call request is made, an LR request is made. If successful the updated state is entered and the call may be made.
- 4): The MS is in the null state from switch on until it has camped on a cell and either made an LR attempt or decided that no LR attempt is needed.
- 5): In this state, IMSI detach is performed if the MS is deactivated and the BCCH indicates that IMSI attach/detach shall be used. An LR request indicating IMSI attach is performed if the MS is activated in the same registration area in which it was deactivated while being in this state.
- 6): A GPRS MS shall not perform a new LR when the new routing area is part of a LA contained in a list of forbidden LA.
- 7): The GPRS registration status "Idle, no IMSI" is entered when LR is rejected with cause "GPRS not allowed". The non-GPRS registration status „Idle, no IMSI“ is entered when the cause "IMSI unknown in HLR" is received.

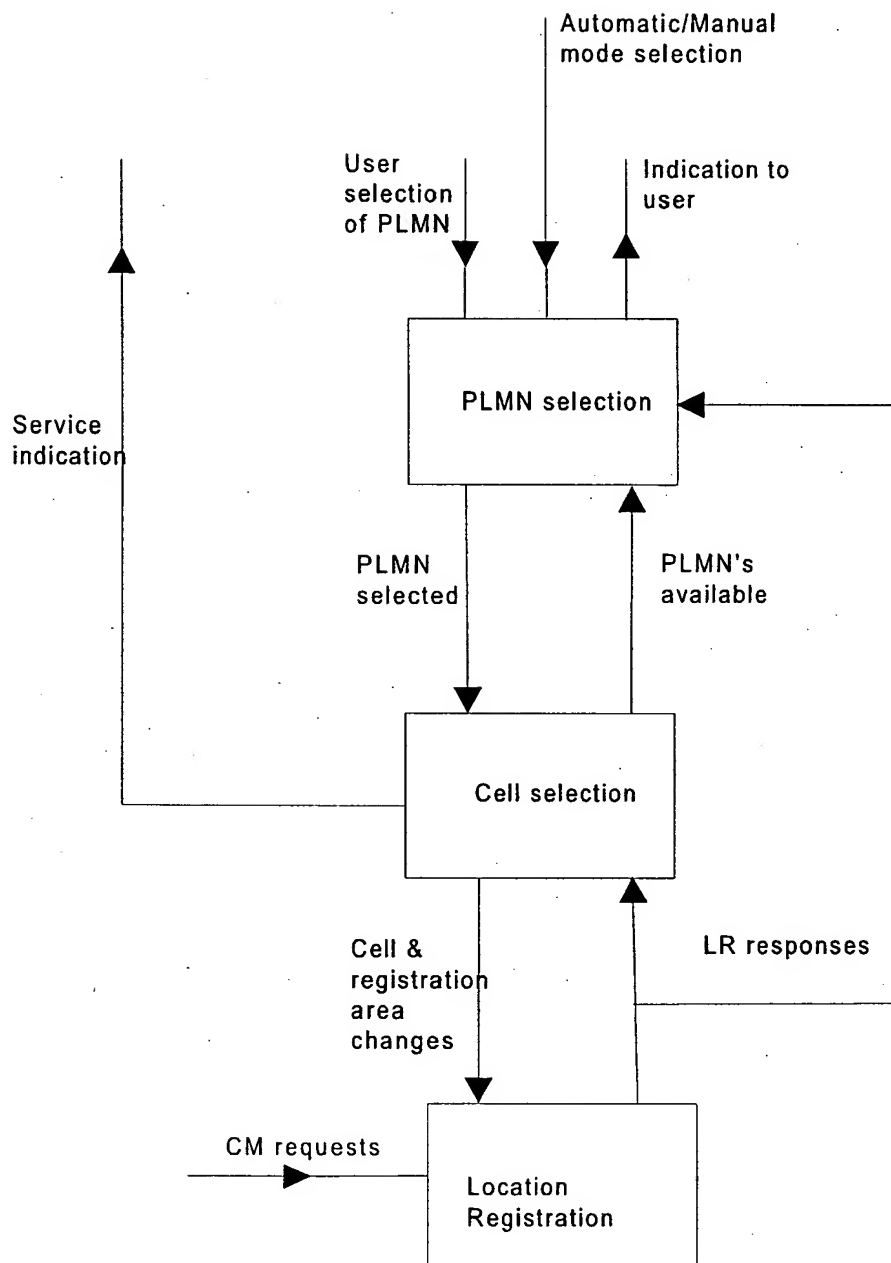


Figure 1: Overall Idle Mode process

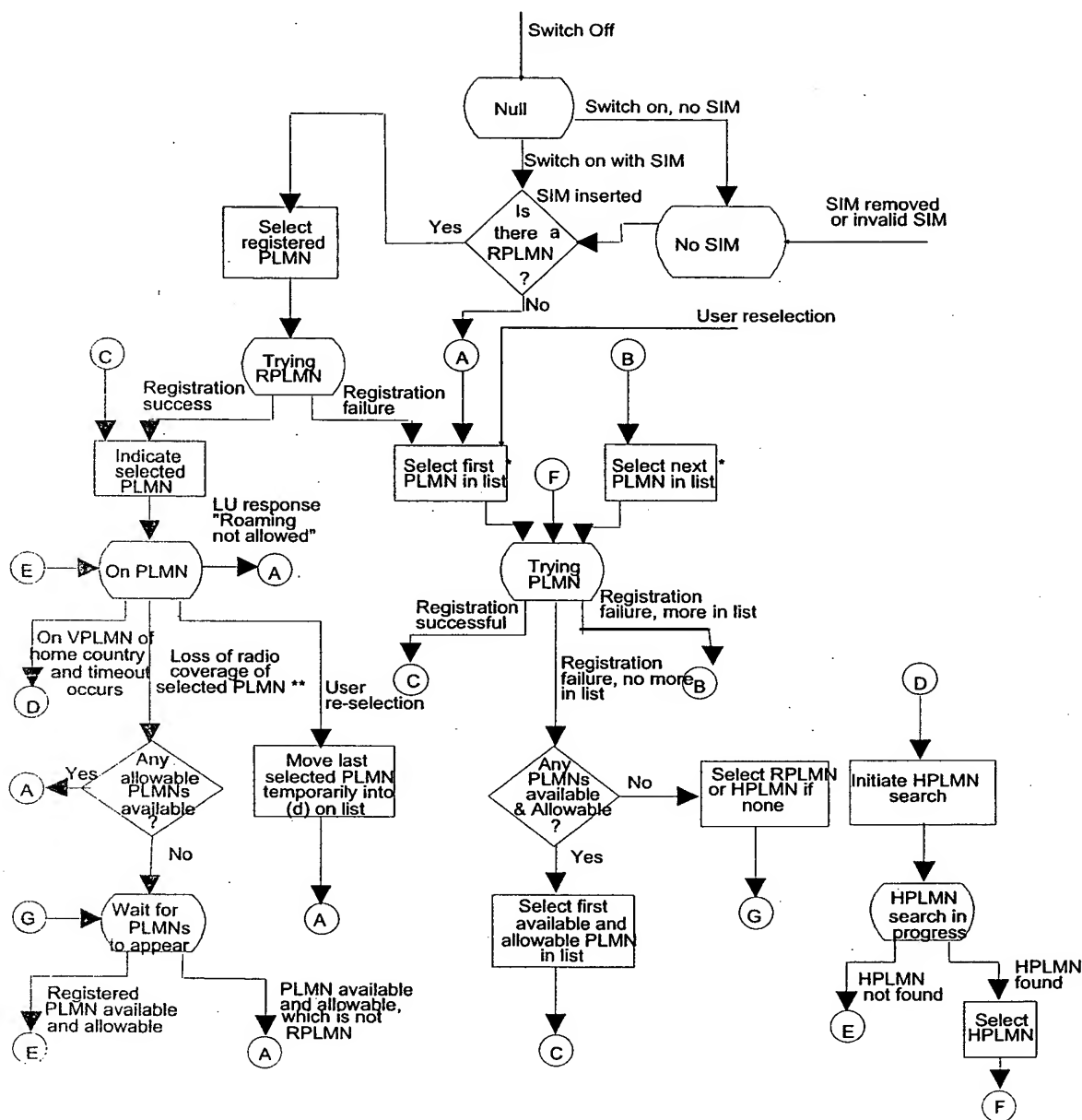


Figure 2a: PLMN Selection State diagram (automatic mode)

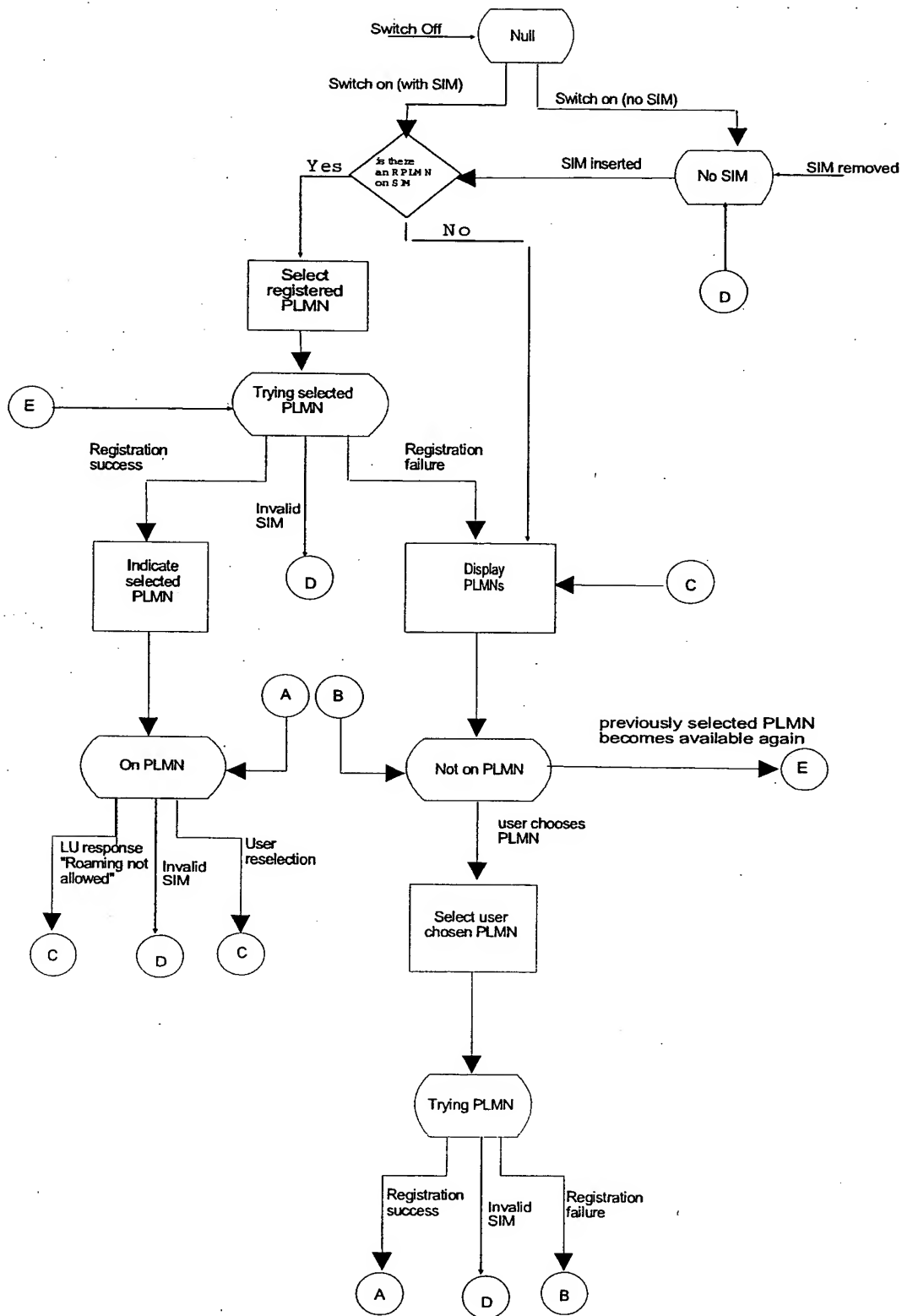


Figure 2b: PLMN Selection State diagram (manual mode)

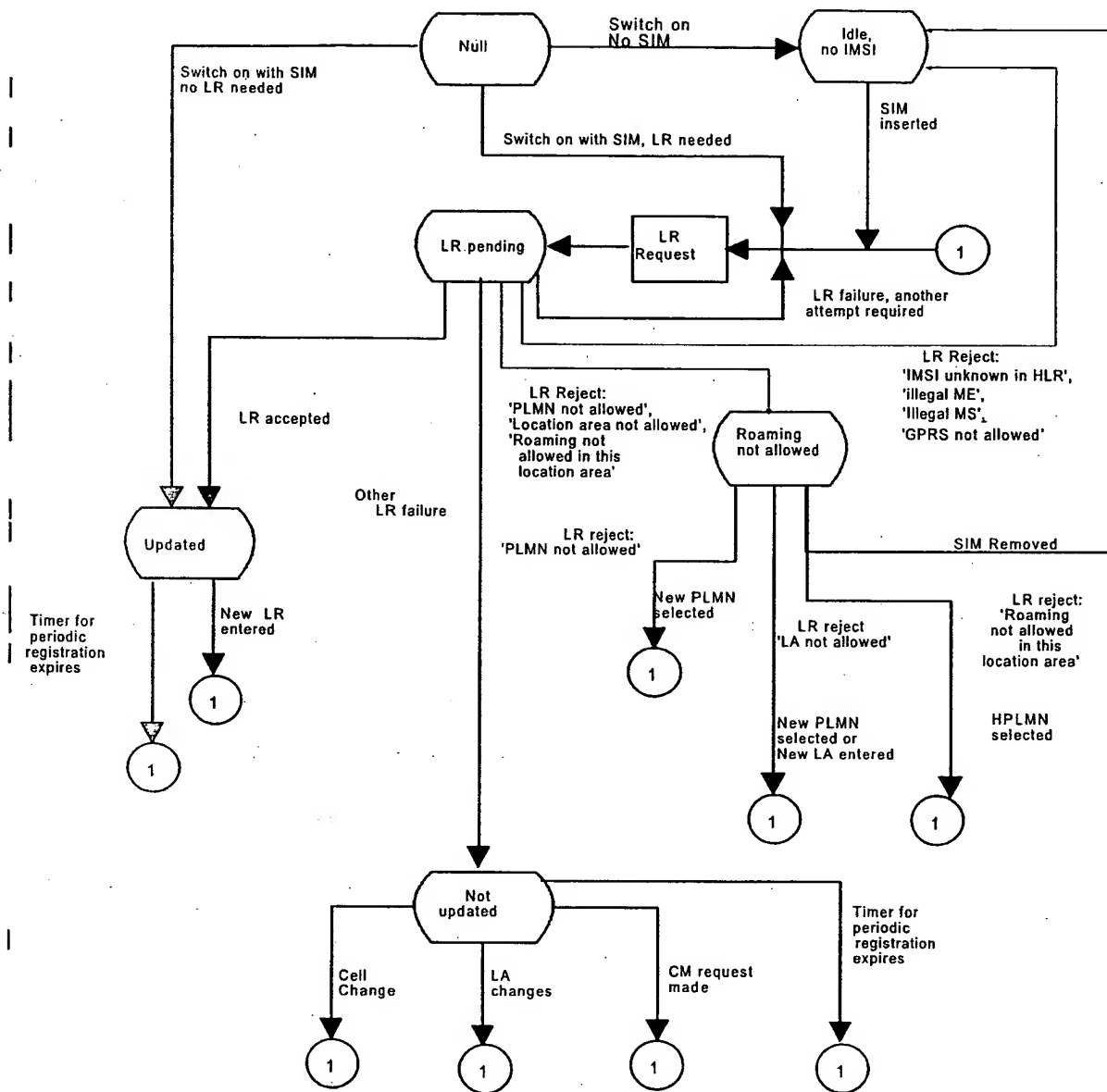


Figure 3: Location Registration Task State diagram

NOTE: Whenever the MS goes to connected mode and then returns to idle mode again the MS selects appropriate state.

NOTE: A MS capable of GPRS and non-GPRS services has two Task State machines one for GPRS and one for non-GPRS operation.

Annex A (normative): HPLMN Matching Criteria

With the introduction of PCS1900 with the regulatory mandate to allocate 3-digit MNC codes, additional functionality is required to identify the HPLMN.

Assumptions

An MNC code shall consist of 2 or 3 decimal digits. In NA PCS1900, all SIMs shall store 3 digit MNCs.

Any network using a 2 digit MNC code shall broadcast the hexadecimal code "F" in place of the 3rd digit.

For PCS1900 for North America, regulations mandate that a 3-digit MNC shall be used; however during a transition period, a 2 digit MNC may be broadcast by the Network and, in this case, the 3rd digit of the SIM is stored as 0 (this is the 0 suffix rule).

With the exception of North America during the transition period:

- a) Within a single country (or area identified by a MCC) all networks shall broadcast a 2 digit MNC code, or all networks shall broadcast a 3 digit MNC code. A mixture of broadcast 2 and 3 digit MNC codes is not permitted within a single country (or area identified by a MCC).
- b) A network which broadcasts a 2 digit MNC code, will issue SIMs with a 2 digit MNC code in the IMSI on the SIM. A network which broadcasts a 3 digit MNC code, will issue SIMs with a 3 digit MNC code in the IMSI on the SIM.

Definitions and abbreviations

BCCH-MCC	The MCC part of the LAI read from System Information type 3 messages broadcast on the BCCH by the network.
BCCH-MNC	The MNC part of the LAI read from System Information type 3 messages broadcast on the BCCH by the network.
SIM-MCC	The MCC part of the IMSI read from the SIM.
SIM-MNC	The MNC part of the IMSI read from the SIM.

HPLMN Matching Criteria in mobiles which don't support PCS1900 for NA:

Figure A.1 illustrates the logic flow described below. The text below is normative. The Figure A.1 is informative.

- (1) The MS shall compare using all 3 digits of the SIM-MCC with the BCCH-MCC. If the values do not match, then the HPLMN match fails.

NOTE: If the MCC codes match, then the number of digits used for the SIM-MNC must be the same as the number of digits used for the BCCH-MNC.

- (2) The MS shall read the 3rd digit of the BCCH-MNC. If the 3rd digit is Hex F, then proceed to step (4).
- (3) The MS shall compare using all 3 digits of the SIM-MNC with the BCCH-MNC. If the values match, then the HPLMN match succeeds, otherwise the HPLMN match fails.
- (4) The MS shall compare using just the 1st 2 digits the SIM-MNC with the BCCH-MNC. If the values match, then the HPLMN match succeeds, otherwise the HPLMN match fails.

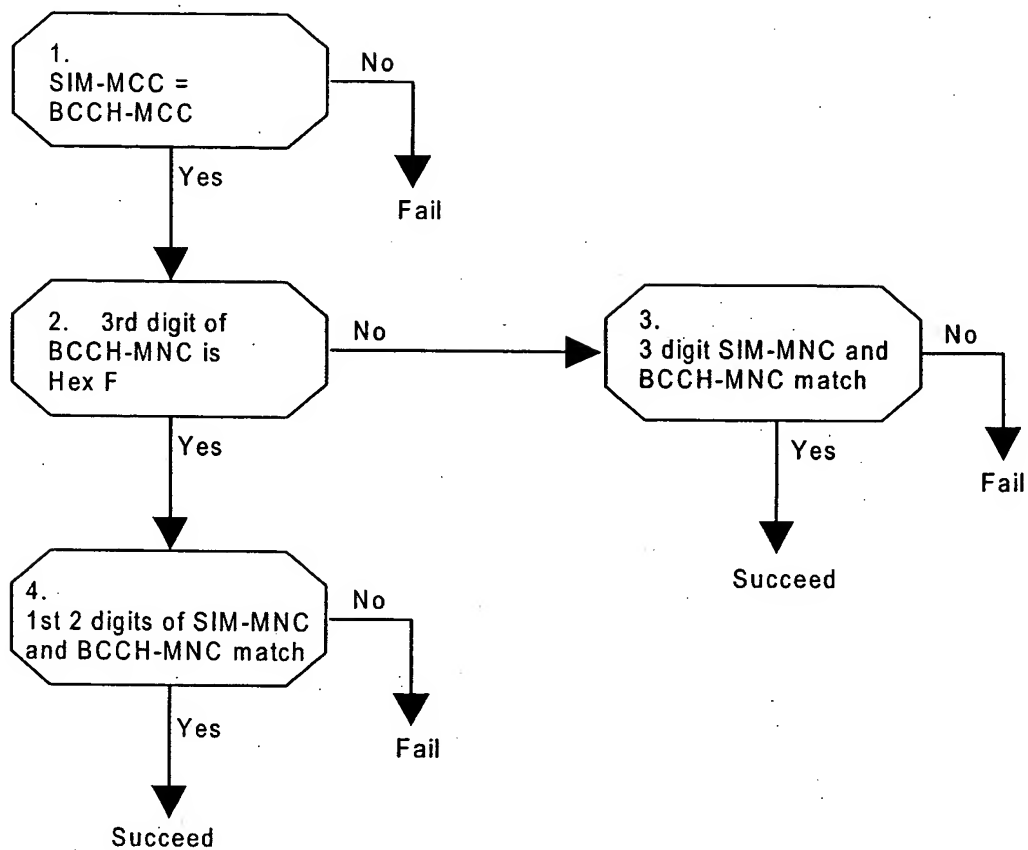


Figure A.1: HPLMN Matching Criteria Logic Flow for mobiles which support GSM and DCS1800 (informative)

HPLMN Matching Criteria for mobiles which support PCS1900 for NA:

Figure A.2 illustrates the logic flow described below. The text below is normative. The Figure A.2 is informative

- (1) The MS shall compare using all 3 digits the SIM-MCC with the BCCH-MCC. If the values do not match, then the HPLMN match fails.
- (2) The MS shall read the 3rd digit of the BCCH-MNC. If the 3rd digit is Hex F, then proceed to step (4).
- (3) The MS shall compare using all 3 digits the SIM-MNC with the BCCH-MNC. If the values match, then the HPLMN match succeeds, otherwise the HPLMN match fails.

NOTE: These rules (1) – (3) are the same as for mobiles which don't support PCS1900 for NA, except step (4) is different.

- (4) The MS shall determine if the BCCH-MCC lies in the range 310-316 (i.e., whether this network is a PCS1900 for NA network). If the BCCH-MCC lies outside the range 310-316, then proceed to step (6).
- (5) The MS shall compare the 3rd digit of the SIM-MNC with '0'. If the 3rd digit is not '0' then the HPLMN match fails.

NOTE: This is the '0' suffix rule.

- (6) The MS shall compare using just the 1st 2 digits of the SIM-MNC with the BCCH-MNC. If the values match, then the HPLMN match succeeds, otherwise the HPLMN match fails.

NOTE: When PCS1900 for NA switches over to broadcasting 3 digit MNCs in all networks, then the additional requirements for PCS1900 for NA can be deleted.

Guidance for Networks in PCS1900 for NA

There may be some problems in the transition period from broadcasting 2 MNC digits to broadcasting 3 MNC digits. Here are some guidelines to avoid these problems.

- (1) Existing network codes. Operators who currently use a 2 digit BCCH-MNC xy should use the new code xy0.
- (2) New operators allocated 3 digit MNC codes with the same 1st 2 digits as an existing operator shall not use a 3rd digit of 0.

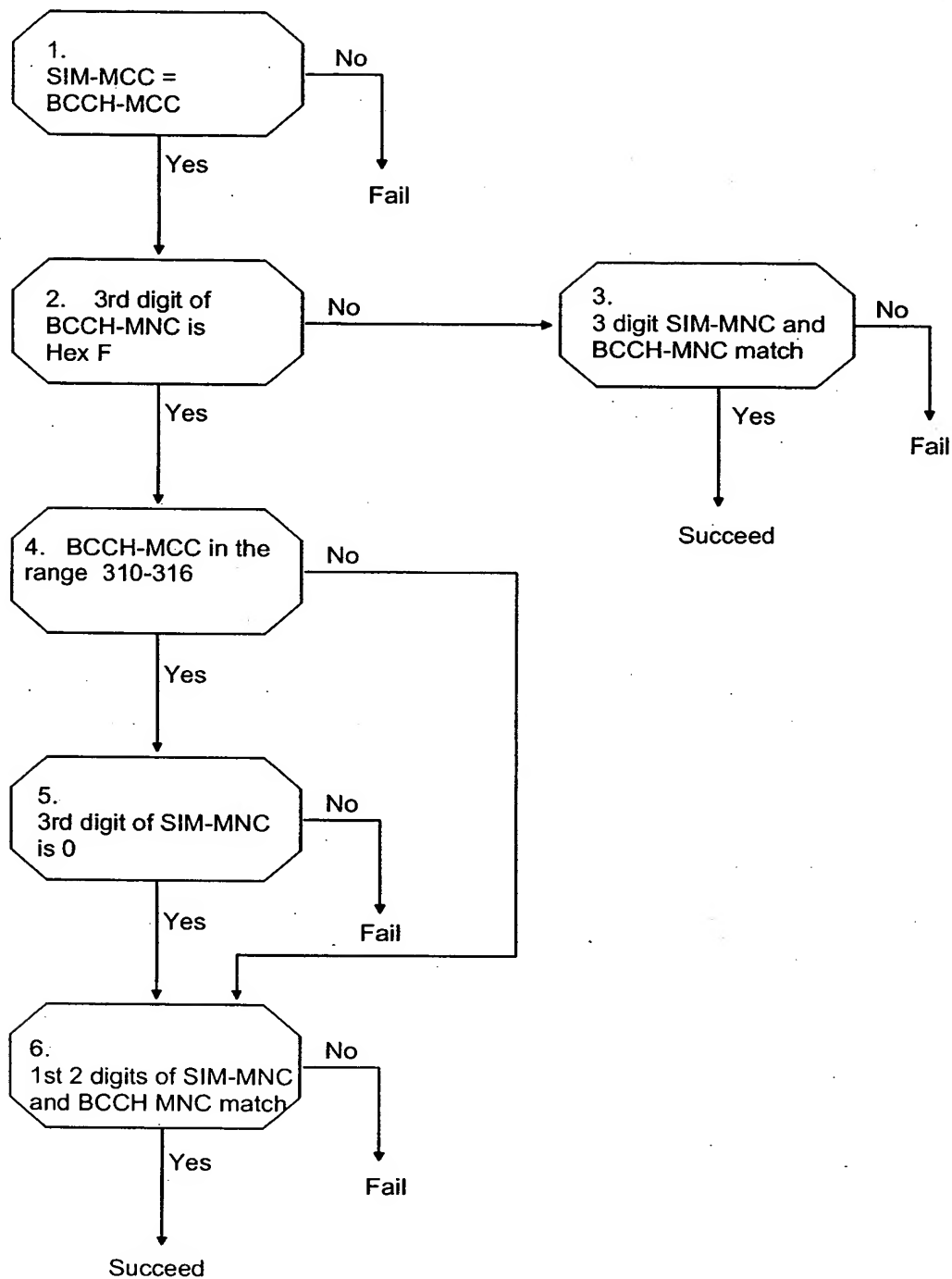


Figure A.2: HPLMN Matching Criteria Logic Flow for mobiles which support PCS1900 for NA (informative)

Annex B (informative): Change history

TSG#	T doc	SPEC	VER	CR	R	PHA	CA	NEW	SUBJECT	comment
		03.22	8.2.0			R99			Split of 03.22/R99 to 03.22 and 23.122	
CN#6		23.122	0.0.0			R99		3.0.0		Was approved in the TSGN#6 plenary
CN#4	N1-99573	23.102	3.0.0	001		R99	F	3.1.0	PLMN selection for GPRS mobiles	Mirrored from CRA032r2
CN#6	N1-99D13	23.122	3.0.0	002		R99	A	3.1.0	Correction of Figure A.2 in Annex A	Mirrored from CR006r1for 23.022

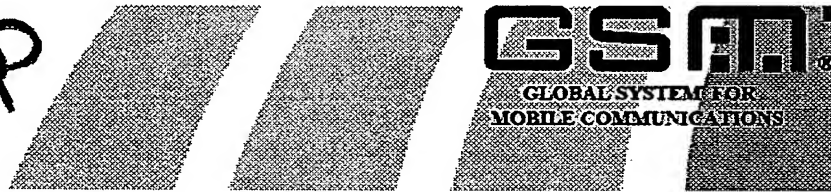
History

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Technical Specification

**Digital cellular telecommunications system (Phase 2+) (GSM);
Universal Mobile Telecommunications System (UMTS);
Mobile radio Interface layer 3 specification,
Core Network protocols - Stage 3
(3G TS 24.008 version 3.2.1 Release 1999)**



4.4 MM specific procedures

A MM specific procedure can only be started if no other MM specific procedure is running or no MM connection exists between the network and the mobile station. The end of the running MM specific procedure or the release of all MM connections have to be awaited before a new MM specific procedure can be started.

During the lifetime of a MM specific procedure, if a MM connection establishment is requested by a CM entity, this request will either be rejected or be delayed until the running MM specific procedure is terminated (this depends on the implementation).

Any MM common procedure (except IMSI detach) may be initiated during a MM specific procedure.

Unless it has specific permission from the network (follow-on proceed) the mobile station side should await the release of the RR connection used for a MM specific procedure before a new MM specific procedure or MM connection establishment is started.

NOTE: The network side may use the same RR connection for MM connection management.

4.4.1 Location updating procedure

The location updating procedure is a general procedure which is used for the following purposes:

- normal location updating (described in this section);
- periodic updating (see section 4.4.2);
- IMSI attach (see section 4.4.3).

The normal location updating procedure is used to update the registration of the actual Location Area of a mobile station in the network. The location updating type information element in the LOCATION UPDATING REQUEST message shall indicate normal location updating. The conditions under which the normal location updating procedure is used by a mobile station in the MM IDLE state are defined for each service state in section 4.2.2.

Only applicable for mobile stations supporting VGCS listening or VBS listening: A mobile station in RR group receive mode is in the MM IDLE state, substate RECEIVING GROUP CALL (NORMAL SERVICE) or RECEIVING GROUP CALL (LIMITED SERVICE). To perform a location updating, the MS in RR group receive mode shall leave the group receive mode, establish an independent dedicated RR connection to perform the location updating as described above and return to the RR group receive mode afterwards.

The normal location updating procedure shall also be started if the network indicates that the mobile station is unknown in the VLR as a response to MM connection establishment request.

To limit the number of location updating attempts made, where location updating is unsuccessful, an attempt counter is used. The attempt counter is reset when a mobile station is switched on or a SIM card is inserted.

Upon successful location updating the mobile station sets the update status to UPDATED in the SIM, and stores the received Location Area Identification in the SIM. The attempt counter shall be reset.

The detailed handling of the attempt counter is described in 4.4.4.6 to 4.4.4.9.

The Mobile Equipment shall contain a list of "forbidden location areas for roaming", as well as a list of "forbidden location areas for regional provision of service". These lists shall be erased when the MS is switched off or when the SIM is removed, and periodically (with period in the range 12 to 24 hours). The location area identification received on the BCCH that triggered the location updating request shall be added to the suitable list whenever a location update reject message is received with the cause "Roaming not allowed in this location area" or with the cause "Location Area not allowed". The lists shall accommodate each 10 or more location area identifications. When the list is full and a new entry has to be inserted, the oldest entry shall be deleted.

The cell selection processes in the different states are described in TS 23.022 and GSM 05.08.

The location updating procedure is always initiated by the mobile station.

4.4.2 Periodic updating

Periodic updating may be used to notify periodically the availability of the mobile station to the network. Periodic updating is performed by using the location updating procedure. The location updating type information element in the LOCATION UPDATING REQUEST message shall indicate periodic updating.

The procedure is controlled by the timer T3212 in the mobile station. If the timer is not already started, the timer is started each time the mobile station enters the MM IDLE substate NORMAL SERVICE or ATTEMPTING TO UPDATE. When the MS leaves the MM Idle State the timer T3212 shall continue running until explicitly stopped.

The timer is stopped (shall be set to its initial value for the next start) when:

- a LOCATION UPDATING ACCEPT or LOCATION UPDATING REJECT message is received;
- an AUTHENTICATION REJECT message is received;
- the first MM message is received, or security mode setting is completed in the case of MM connection establishment, except when the most recent service state is LIMITED SERVICE;
- the mobile station has responded to paging and thereafter has received the first correct layer 3 message except RR message;
- the mobile station is deactivated (i.e. equipment powered down or SIM removed).

When the timer T3212 expires, the location updating procedure is started and the timer shall be set to its initial value for the next start. If the mobile station is in other state than MM Idle when the timer expires the location updating procedure is delayed until the MM Idle State is entered.

The conditions under which the periodic location updating procedure is used by a mobile station in the MM IDLE state are defined for each service state in section 4.2.2.

If the mobile station is in service state NO CELL AVAILABLE, LIMITED SERVICE, PLMN SEARCH or PLMN SEARCH-NORMAL SERVICE when the timer expires the location updating procedure is delayed until this service state is left.

In GSM, the (periodic) location updating procedure is not started if the BCCH information at the time the procedure is triggered indicates that periodic location shall not be used. The timeout value is broadcasted in the L3-RR SYSTEM INFORMATION TYPE 3 message on the BCCH, in the Control channel description IE, see GSM 04.18 section 10.5.2.11.

In UMTS, the (periodic) location updating procedure is not started if the information on BCCH or in the last received dedicated system information at the time the procedure is triggered indicates that periodic location shall not be used. The timeout value is broadcasted in the L3-RRC SYSTEM INFORMATION BLOCK 1 message on the BCCH, see TS 25.331 section 10.1.6.4.3.

The T3212 timeout value shall not be changed in the NO CELL AVAILABLE, LIMITED SERVICE, PLMN SEARCH and PLMN SEARCH-NORMAL SERVICE states.

When a change of the T3212 timeout value has to be taken into account and the timer is running (at change of the serving cell or, change of the broadcast value of T3212), the MS shall behave as follows:

Let t_1 be the new T3212 timeout value and let t be the current timer value at the moment of the change to the new T3212 timeout value; then the timer shall be restarted with the value $t \bmod t_1$.

When the mobile station is activated, or when a change of the T3212 timeout value has to be taken into account and the timer is not running, the mobile station shall behave as follows:

Let t_1 be the new T3212 timeout value, the new timer shall be started at a value randomly, uniformly drawn between 0 and t_1 .

4.4.3 IMSI attach procedure

The IMSI attach procedure is the complement of the IMSI detach procedure (see section 4.3.4). It is used to indicate the IMSI as active in the network.

In GSM, a flag (ATT) is broadcast in the L3-RR SYSTEM INFORMATION TYPE 3 message. It indicates whether the attach and detach procedures are required to be used or not.

In UMTS, a flag (ATT) is broadcast in the L3-RRC SYSTEM INFORMATION BLOCK 1 message. It indicates whether the attach and detach procedures are required to be used or not.

The IMSI attach procedure is invoked if the detach/attach procedures are required by the network and an IMSI is activated in a mobile station (i.e. activation of a mobile station with plug-in SIM, insertion of a card in a card-operated mobile station etc.) within coverage area from the network or a mobile station with an IMSI activated outside the coverage area enters the coverage area. The IMSI attach procedure is used only if the update status is UPDATED and if the stored Location Area Identification is the same as the one which is actually broadcasted on the BCCH of the current serving cell. Otherwise a normal location updating procedure (see section 4.4.1) is invoked independently of the ATT flag indication.

IMSI attach is performed by using the location updating procedure. The location updating type information element in the LOCATION UPDATING REQUEST message shall in this case indicate IMSI attach.

4.4.4 Generic Location Updating procedure

4.4.4.1 Location updating initiation by the mobile station

Any timer used for triggering the location updating procedure (e.g. T3211, T3212) is stopped if running.

As no RR connection exists at the time when the location updating procedure has to be started, the MM sublayer within the mobile station will request the RR sublayer to establish a RR connection and enter state WAIT FOR RR CONNECTION (LOCATION UPDATE). The procedure for establishing an RR connection is described in GSM 04.18 section 3.3 and TS 25.331 section 8.2.3.

The mobile station initiates the location updating procedure by sending a LOCATION UPDATING REQUEST message to the network, starts the timer T3210 and enters state LOCATION UPDATING INITIATED. The location updating type information element shall indicate what kind of updating is requested.

4.4.4.1a Network Request for Additional mobile station Capability Information

In GSM, the network may initiate the classmark interrogation procedure, for example, to obtain further information on the mobile station's encryption capabilities.

4.4.4.2 Identification request from the network

The network may initiate the identification procedure, e.g. if the network is unable to get the IMSI based on the TMSI and LAI used as identification by the mobile station (see section 4.3.3).

4.4.4.3 Authentication by the network

The authentication procedure (see section 4.3.2) may be initiated by the network upon receipt of the LOCATION UPDATING REQUEST message from the mobile station. (See the cases defined in GSM 02.09).

4.4.4.4 Security mode setting by the network

In GSM, the security mode setting procedure (see GSM 04.18 section 3.4.7) may be initiated by the network, e.g., if a new TMSI has to be allocated.

In UMTS, the security mode control procedure (see TS 25.331 section 8.1.10) may be initiated by the network, e.g., if a new TMSI has to be allocated.

4.4.4.5 Attempt Counter

To limit the number of location updating attempts made, where location updating is unsuccessful, an attempt counter is used. It counts the number of consecutive unsuccessful location update attempts.

The attempt counter is incremented when a location update procedure fails. The specific situations is specified in section 4.4.4.9.

The attempt counter is reset when:

- the mobile station is powered on;
- a SIM is inserted;
- location update is successfully completed;
- location update completed with cause #11, #12 or #13 (see section 4.4.4.7).

and in case of service state ATTEMPTING to UPDATE:

- a MS detects that a new location area is entered;
- expiry of timer T3212;
- location update is triggered by CM sublayer requests.

The attempt counter is used when deciding whether to re-attempt a location update after timeout of timer T3211.

4.4.4.6 Location updating accepted by the network

If the location updating is accepted by the network a LOCATION UPDATING ACCEPT message is transferred to the mobile station.

In case the identity confidentiality service is active (see section 4.3.1 and 4.4.4.4), the TMSI reallocation may be part of the location updating procedure. The TMSI allocated is then contained in the LOCATION UPDATING ACCEPT message together with the location area identifier LAI. The network shall in this case start the supervision timer T3250 as described in section 4.3.1.

If the network wishes to prolong the RR connection to allow the mobile station to initiate MM connection establishment (for example if the mobile station has indicated in the LOCATION UPDATING REQUEST that it has a follow-on request pending) the network shall send "follow on proceed" in the LOCATION UPDATING ACCEPT and start timer T3255.

The mobile station receiving a LOCATION UPDATING ACCEPT message shall store the received location area identification LAI, stop timer T3210, reset the attempt counter and set the update status in the SIM to UPDATED. If the message contains an IMSI, the mobile station is not allocated any TMSI, and shall delete any TMSI in the SIM accordingly. If the message contains a TMSI, the mobile station is allocated this TMSI, and shall store this TMSI in the SIM and a TMSI REALLOCATION COMPLETE shall be returned to the network. If neither IMSI nor TMSI is received in the LOCATION UPDATING ACCEPT message, the old TMSI if any available shall be kept.

If the LAI or PLMN identity contained in the LOCATION UPDATING ACCEPT message is a member of any of the "forbidden lists" then any such entries shall be deleted.

After that, the mobile station shall act according to the presence of the "Follow-on proceed" information element in the LOCATION UPDATING ACCEPT; if this element is present and the mobile station has a CM application request pending, it shall send a CM SERVICE REQUEST to the network and proceed as in section 4.5.1.1. Otherwise, it shall start timer T3240 and enter state WAIT FOR NETWORK COMMAND.

Furthermore, the network may grant authorisation for the mobile station to use GSM-Cordless Telephony System (CTS) in the Location Area and its immediate neighbourhood. The mobile should memorise this permission in non-volatile memory. If the "CTS permission" IE is not present in the message, the mobile is not authorised to use GSM-CTS, and shall accordingly delete any memorised permission.

NOTE: the interaction between CTS and GPRS procedures are not yet defined.

4.4.4.7 Location updating not accepted by the network

If the location updating cannot be accepted the network sends a LOCATION UPDATING REJECT message to the mobile station. The mobile station receiving a LOCATION UPDATING REJECT message shall stop the timer T3210, store the reject cause, start T3240, enter state LOCATION UPDATING REJECTED await the release of the RR connection triggered by the network. Upon the release of the RR connection the mobile station shall take the following actions depending on the stored reject cause:

- # 2: IMSI unknown in HLR;

3: Illegal MS; or

6: Illegal ME.

The mobile station shall set the update status to ROAMING NOT ALLOWED (and store it in the SIM according to section 4.1.2.2), and delete any TMSI, stored LAI and ciphering key sequence number and shall consider the SIM as invalid until switch-off or the SIM is removed.

11: PLMN not allowed;

12: Location Area not allowed; or

13: Roaming not allowed in this location area.

The mobile station shall delete any LAI, TMSI and ciphering key sequence number stored in the SIM, reset the attempt counter, set the update status to ROAMING NOT ALLOWED (and store it in the SIM according to section 4.1.2.2). The mobile station shall store the LAI or the PLMN identity in the suitable forbidden list, i.e. in the "forbidden PLMN list" for cause #11, in the list of "forbidden location areas for regional provision of service" for cause #12, and in the list of "forbidden location areas for roaming" for cause #13. In addition, the MS will memorize if cause #13 was received, so to perform a PLMN selection instead of a cell selection when back to the MM IDLE state.

Other values are considered as abnormal cases and the specification of the mobile station behaviour in those cases is given in section 4.4.4.9.

4.4.4.8 Release of RR connection after location updating

When the Location updating procedure is finished (see sections 4.4.4.6 and 4.4.4.7) the mobile station shall (except in the case where the mobile has a follow-on CM application request pending and has received the follow-on proceed indication, see 4.4.4.6) set timer T3240 and enter the state WAIT FOR NETWORK COMMAND, expecting the release of the RR connection. The network may decide to keep the RR connection for network initiated establishment of a MM connection, or to allow for mobile initiated MM connection establishment.

Any release of the RR connection shall be initiated by the network according to section 3.5 in GSM 04.18, and section 8.2.1 in TS 25.331. If the RR connection is not released within a given time controlled by the timer T3240, the mobile station shall abort the RR connection. In both cases, either after a RR connection release triggered from the network side or after a RR connection abort requested by the MS-side, the MS shall return to state MM IDLE.

At transition to state MM IDLE, substates NORMAL SERVICE or RECEIVING GROUP CALL (NORMAL SERVICE) or ATTEMPTING TO UPDATE either timer T3212 or timer T3211 is started as described in section 4.4.4.9.

4.4.4.9 Abnormal cases on the mobile station side

The different abnormal cases that can be identified are the following:

a) Access barred because of access class control

The location updating procedure is not started. The mobile station stays in the current serving cell and applies normal cell reselection process. The procedure is started as soon as possible and if still necessary (when the barred state is ended or because of a cell change)

b) The answer to random access is an IMMEDIATE ASSIGNMENT REJECT message

The location updating is not started. The mobile station stays in the chosen cell and applies normal cell selection process. The waiting timer T3122 is reset when a cell change occurs. The procedure is started as soon as possible after T3122 timeout if still necessary.

c) Random access failure

Timer T3213 is started. When it expires the procedure is attempted again if still necessary.

NOTE: As specified in GSM 05.08, a cell reselection then takes place, with return to the cell inhibited for 5 seconds if there is at least one other suitable cell. Typically the selection process will take the mobile station back to the cell where the random access failed after 5 seconds.

If at the expiry of timer T3213 a new cell has not been selected due to the lack of valid information (see GSM 05.08), the mobile station may as an option delay the repeated attempt for up to 8 seconds to allow cell re-selection to take place. In this case the procedure is attempted as soon as a new cell has been selected or the mobile station has concluded that no other cell can be selected.

If random access failure occurs for two successive random access attempts for location updating the mobile station proceeds as specified below.

d) RR connection failure

The procedure is aborted and the mobile station proceeds as specified below.

e) T3210 timeout

The procedure is aborted, the RR connection is aborted and the MS proceeds as specified below.

f) RR release before the normal end of procedure

The procedure is aborted and the mobile station proceeds as specified below.

g) Location updating reject, other causes than those treated in section 4.4.4.7

The MS waits for release of the RR connection as specified in section 4.4.4.8, and then proceeds as specified below.

In cases d) to g) above and for repeated failures as defined in c) above the mobile station proceeds as follows. Timer T3210 is stopped if still running. The RR Connection is aborted in case of timer T3210 timeout. The attempt counter is incremented. The next actions depend on the Location Area Identities (stored and received from the BCCH of the current serving cell) and the value of the attempt counter.

- the update status is UPDATED, and the stored LAI is equal to the one received on the BCCH from the current serving cell and the attempt counter is smaller than 4:

The mobile station shall keep the update status to UPDATED, the MM IDLE sub-state after the RR connection release is NORMAL SERVICE. The mobile station shall memorize the location updating type used in the location updating procedure. It shall start timer T3211 when the RR connection is released. When timer T3211 expires the location updating procedure is triggered again with the memorized location updating type;

- either the update status is different from UPDATED, or the stored LAI is different from the one received on the BCCH from the current serving cell, or the attempt counter is greater or equal to 4:

The mobile station shall delete any LAI, TMSI, ciphering key sequence number stored in the SIM, set the update status to NOT UPDATED and enter the MM IDLE sub-state ATTEMPTING TO UPDATE when the RR connection is released (See section 4.2.2.2 for the subsequent actions). If the attempt counter is smaller than 4, the mobile station shall memorize that timer T3211 is to be started when the RR connection is released, otherwise it shall memorize that timer T3212 is to be started when the RR connection is released.

4.4.4.10 Abnormal cases on the network side

a) RR connection failure

If a RR connection failure occurs during a common procedure integrated with the location updating procedure, the behaviour of the network should be according to the description of that common procedure.

If a RR connection failure occurs when a common procedure does not exist, the location updating procedure towards the mobile station should be aborted.

b) protocol error

If the LOCATION UPDATING REQUEST message is received with a protocol error, the network should, if possible, return a LOCATION UPDATING REJECT message with one of the following Reject causes:

#96: Mandatory information element error

#99: Information element non-existent or not implemented

#100: Conditional IE error

#111: Protocol error, unspecified

Having sent the response, the network should start the channel release procedure (see section 3.5).

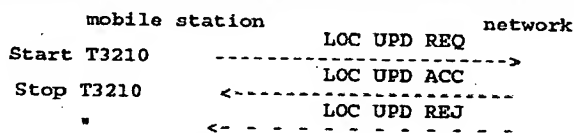


Figure 4.5/TS 24.008: Location updating sequence

4.5 Connection management sublayer service provision

The concept of MM connection is introduced in this section. This concept is mainly a descriptive tool: The establishment of an MM connection by the network can be local (i.e. it is achieved by the transmission of the first CM layer message and without the transmission of any MM layer messages) or can be achieved by the transmission of a CM SERVICE PROMPT message (eg. in the case of certain ring back services). The release of an MM connection by the network or by the mobile station is always local, i.e. these purposes can be achieved without sending any MM messages over the radio interface. (On the contrary, establishment of an MM connection by the mobile station requires the sending of MM messages over the radio interface. An exception is VGCS, where an MM connection will be established as result of an uplink access procedure (see section 3.7.2.1.1 in GSM 04.18).)

The Mobility Management (MM) sublayer is providing connection management services to the different entities of the upper Connection management (CM) sublayer (see TS 24.007). It offers to a CM entity the possibility to use an MM connection for the exchange of information with its peer entity. An MM connection is established and released on request from a CM entity. Different CM entities communicate with their peer entity using different MM connections. Several MM connections may be active at the same time.

An MM connection requires an RR connection. All simultaneous MM connections for a given mobile station use the same RR connection.

In the following sections, the procedures for establishing, re-establishing, maintaining, and releasing an MM connection are described, usually separately for the mobile station and the network side.

4.5.1 MM connection establishment

4.5.1.1 MM connection establishment initiated by the mobile station

Upon request of a CM entity to establish an MM connection the MM sublayer first decides whether to accept, delay, or reject this request:

- An MM connection establishment may only be initiated by the mobile station when the following conditions are fulfilled:
 - Its update status is UPDATED.
 - The MM sublayer is in one of the states MM IDLE or MM connection active but not in MM connection active (Group call).

An exception from this general rule exists for emergency calls (see section 4.5.1.5). A further exception is defined in the following clause.

- If an MM specific procedure is running at the time the request from the CM sublayer is received, and the LOCATION UPDATING REQUEST message has been sent, the request will either be rejected or delayed, depending on implementation, until the MM specific procedure is finished and, provided that the network has not sent a "follow-on proceed" indication, the RR connection is released. If the LOCATION UPDATING REQUEST message has not been sent, the mobile station may include a "follow-on request" indicator in the message. The mobile station shall then delay the request until the MM specific procedure is completed, when it may be given the opportunity by the network to use the RR connection: see section 4.4.4.6.

4.2.2.2 Service State, ATTEMPTING TO UPDATE

When in state MM IDLE and service state ATTEMPTING TO UPDATE the mobile station shall:

- perform location updating procedure at expiry of timer T3211 or T3213;
- perform normal location updating when the location area identification of the serving cell changes;
- if entry into this state was caused by c) or d) or f) (with cause different from "abnormal release, unspecified") or g) (with cause "retry upon entry into a new cell") of section 4.4.4.9, then location updating shall be performed when a new cell is entered;
- if entry into this state was caused by e) or f) (with cause "abnormal release, unspecified") or g) (with cause different from "retry upon entry into a new cell") of section 4.4.4.9, then location updating shall not be performed because a new cell is entered;
- perform normal location updating at expiry of timer T3212;
- not perform IMSI detach;
- support request for emergency calls;
- use other request from CM layer as triggering of normal location updating procedure (if the location updating procedure is successful, then the request for MM connection is accepted, see section 4.5.1);
- respond to paging (with IMSI).

In addition, mobile stations supporting VGCS listening or VBS listening shall:

- indicate notifications to the GCC or BCC sublayer for which a channel description has been received in the notification by the RR sublayer;

ETSI

11 List of system parameters

The description of timers in the following table should be considered a brief summary. The precise details are found in sections 3 to 6, which should be considered the definitive descriptions.

11.1 Timers and counters for radio resource management

See 04.18

11.2 Timers of mobility management

Table 11.1/TS 24.008: Mobility management timers - MS-side

TIMER NUM.	MM ST AT	TIME OUT VAL.	CAUSE FOR START	NORMAL STOP	AT THE EXPIRY
T3210	3	20s	-LOC_UPD_REQ sent	- LOC_UPD_ACC - LOC_UPD_REJ - AUTH_REJ - Lower layer failure	Start T3211
T3211	1 2	15s	-LOC_UPD_REJ with cause #17 netw. failure -lower layer failure or RR conn. released after RR conn. abort during loc. updating	- Time out - call change - request for MM connec- tion establish- ment - change of LA	Restart the location up- date proc.
T3212	1, 2	Note 1	-termination of MM ser- vice or MM signalling	-initiation of MM ser- vice or MM signalling	initiate periodic updating
T3213	1 2 11	4s	-location up- dating fai- lure	- expiry - change of BCCH para- meter	new random attempt
T3220	7	5s	-IMSI DETACH	- release from RM- sublayer	enter Null or Idle, AT- TEMPTING TO UPDATE
T3230	5	15s	-CM SERV REQ CM REEST REQ	- Cipher mode setting - CM SERV REJ - CM SERV ACC	provide release ind.
T3240	9 10	10s	see section 11.2.1	see section 11.2.1	abort the RR connec- tion

NOTE 1: The timeout value is broadcasted in a SYSTEM INFORMATION message